original sequence and the received sequence only correlate at the point of alignment, that is between times T_1 and T_2. Thus, noise on the reflection signal is disbursed over the time period of the correlation process. Correlation serves as a summation only at the point of correlation thereby reducing the effects of the noise. Hence, noise is a smaller portion 822 of the correlated signal because the noise is spread. Thus, the invention reduces the effect of noise on the line.

Another advantage of sequence signal is that it allows for the transmission of a lower power signal over the channel. Use of a low power signal eliminates interference, such as from crosstalk, with other adjacent lines, such as other pairs in the binder. Use of a low power signal provides the further advantage of enablement using an integrated circuit, such as built into a modem, which reduces overall power usage.

It is contemplated that the power level of the sequence may be of any magnitude. In one embodiment the power level may be constrained by applicable standards such as the ITU G.shdsl or ANSI HDSL2 standards. This may be implemented by use of transmit filtering which conforms to the power spectral density constraints imposed by those standards. Since the sequence signal may be a valid data signal, it may conform to the standard specifications if the same transmit filtering is employed. This is not true in general for single pulse systems, which may use an undesirable high power pulse as the signal wake-up signal.

In one embodiment the peak voltage of the sequence signal is less than 6 volts. In another embodiment, the peak voltage of the sequence signal is between 6 volts and 18

volts. In yet another embodiment, the peak voltage of the sequence signal is higher than 18 volts. This are but example ranges. Any peak voltage or power level may be selected.

Figure 9 illustrates a plot of frequency components 900 of a periodic sequence on a graph of frequency 904 and spectral amplitude 908. The frequency domain sequence 900 hence appears as an impulse signal having period 912 of the symbol rate divided by sequence period. This representation can be arrived at by performing the Fourier transform (FT) on the sequence signal. This representation of the sequence can be processed by tone detecting receivers. This capability is desirable to maintain backwards capability with other systems that operated as tone based systems. For example, in one embodiment, tones at 12Khz and/or 20Khz may be used to designate a wake-up request to maintain capability.

In one configuration, the scrambler or other device with similar capabilities generates a sequence defined by varying the polynomial of the sequence generator to provide different wakeup signals signals. In another configuration the polynomial is selected to maximize the period of the sequence, such as to create an M-sequence. As described above, the period of a length maximized sequence is defined as 2^m -1 where m is the number of stages of the shift registers used to generate the sequence.

By varying the number of stages m, the period is controlled. Various advantages may be gained by varying the period of the sequence. For example, one advantage of increasing the period of the sequence when used according to the invention for activation is a spreading of the noise, represented in Figure 2

by N(t), over the period of the sequence. Spreading the noise reduces the effect of the noise components that become part of the warm start signal during transmission of the warm start signal through the line. This improves the performance of the activation. When the wakeup signal is used for channel estimation, increasing the period of the sequence enables probing based on more probing tones with finer frequency spacing. Another advantage of increasing the period of the sequence is that the line probing can provide longer impulse responses.

An advantage of a shorter period generated by using a smaller *m* value is that the sequence may be generated and analyzed more rapidly. This speeds the line probe process. Another advantage of shorter period sequences is a lowering of the computational complexity in the receiver.

Figure 10 illustrates an exemplary timing diagram of an example pattern of communication between a central office (CO) communication device 1000 and a customer premise equipment (CPE) 1050. At a time at and up to T0 the CO and CPE are in a powered down or reduced power state. This reduces power usage. Thereafter, at a time period T1, the CPE transmits a wake-up sequence signal. As discussed above, utilizing a sequence signal as a warm-start signal has advantages over the prior art. Thereafter, during a time T2, the CO receives the signal and processes the signal. If the sequence signal sent during period T1 is determined to be a warm-start request signal, then during a time period T3, the CO transmits a response signal or acknowledgement to